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5.8 PALEONTOLOGICAL RESOURCES

This section analyzes the potential environmental effects on paleontological resources that could result from the construction and operation of the Watson Cogeneration Steam and Electric Reliability Project (Project). After this introduction, Section 5.8 is organized as follows:

- Section 5.8.1, Affected Environment, describes the existing environment that could be affected by the Project.
- Section 5.8.2, Environmental Consequences, describes the potential effects on paleontological resources resulting from construction and operation of the Project.
- Section 5.8.3, Cumulative Effects, describes the cumulative effects to paleontological resources.
- Section 5.8.4, Mitigation Measures, discusses the mitigation measures proposed to reduce potential adverse effects to paleontological resources.
- Section 5.8.5, Laws, Ordinances, Regulations, and Standards, lists the federal, state, county, and city laws, ordinances, regulations, and standards (LORS), including professional standards, that protect paleontological resources. Agencies and Agency Contacts, shows the involved agencies and agency contacts. Permits required and permit schedule, discusses the status of permits required and permit schedule.
- Finally, Section 5.8.6, References, lists the references used in preparing this document.

Paleontological resources (fossils) are the remains or traces of prehistoric animals and plants. Fossils are important scientific and educational resources because of their use in the activities listed below.

1. Documenting the presence and evolutionary history of particular groups of now extinct organisms.
2. Reconstructing the environments in which these organisms lived.
3. Determining the relative ages of the strata in which they occur.
4. Determining the geologic events that resulted in the deposition of the sediments in which they were buried.

This paleontological resources inventory and analysis was prepared by Dr. Lanny H. Fisk, Ph.D., Professional Geologist (PG), a California-registered PG and Principal Paleontologist; and Stephen J. Blakely, Staff Paleontologist, both with PaleoResource Consultants. The resources inventory and analysis meets all requirements of the California Energy Commission (CEC) (2007) and the standard measures for mitigating adverse construction-related environmental effects on significant paleontological resources established by the Society of Vertebrate Paleontology (SVP) (1995, 1996; see Appendix K, Confidential Paleontological Resources Technical Report, Appendix A, Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontological Resources–Standard Guidelines, and Appendix B, Conditions of Receivership for Paleontological Salvage Collections).

5.8.1 Affected Environment

5.8.1.1 Geographic Location

As proposed by Watson Cogeneration Company (Watson), the Project Site is located within the Los Angeles Basin in the City of Carson, in southern Los Angeles County, California within Township 4 South, Range 13 West (Figure 3-1, Regional Map). The site is east of Wilmington Avenue and north of East Sepulveda Boulevard with its center approximately at latitude 33º 48' 59" north and longitude 118º 14' 47" west. The Project would impact Section 16 within Township 4 South, Range 13 West on the Long Beach United States Geological Survey (USGS) 7.5-minute quadrangle. The Project Site is level and graded, and the elevation is about 32 feet (about 10.5 meters) above sea level. The Project Site is a 2.5-acre brown field site located within the boundary of the existing Watson Cogeneration Facility, which is a 21.7-acre area within the 428-acre parcel further described as Assessors Parcel Number (APN) 7315-006-003, 1801 Sepulveda Boulevard, Carson, California, 90745 and is integral to BP's existing Carson Refinery (BP Refinery). The street address of the Project Site is located within the boundary of the existing Watson Cogeneration Facility at 22850 South Wilmington Avenue, Carson, California.

The Los Angeles Basin is within the Peninsular Ranges Geomorphic Province and is bounded by the Santa Monica Mountains and the Elysian, Repetto, and Puente Hills to the north, the Santa Ana Mountains to the east, and the San Joaquin Hills to the southeast (Figure 3-1, Regional Map). The Los Angeles Basin is near the northern extent of the northwest-oriented Peninsular Ranges Physiographic Province, which is south of the Transverse Ranges and between the Colorado Desert Physiographic Province and the Pacific Ocean. Within the Peninsular Ranges, primary features including ranges, basins, and faults are generally oriented northwest, parallel with the coastline (Yerkes et al. 1965). Accessible roads to the Project Site include Wilmington Avenue and East 223rd Street.

5.8.1.2 Regional Geologic Setting

The general geology of the Project vicinity and the Los Angeles Basin area has been described in some detail by Arnold and Arnold (1902), Tieje (1926), Woodring et al. (1946), Yerkes et al. (1965), Kennedy (1975), Wright (1987a), Yule and Zenger (1987), Ponti (1989, 2007), Schwartz and Colburn (1989), Brown and Ehlert (2000), Jacobs et al. (2000), California Division of Mines and Geology (DMG) (2001), Hillhouse et al. (2002), McCulloh and Beyer (2004), Bilodeau et al. (2007), and Powell and Ponti (2007). Surficial geologic mapping in the Project vicinity has been provided at a scale of 1:750,000 by Jennings et al. (1977); at a scale of 1:500,000 by Jenkins (1938); at a scale of 1:250,000 by Jennings (1962); at a scale of 1:100,000 by Saucedo et al. (2003); and at a scale of 1:24,000 by Dibblee (1999) and DMG (2001).

The information in these geologic maps and published and unpublished reports form the basis of the following discussion. Individual maps and publications are incorporated into this report and referenced where appropriate. The aspects of geology pertinent to this report are the types, distribution, and age of sediments immediately underlying the Project Site, and their probability of producing fossils during Project construction. The site-specific geology in the vicinity of the Project is discussed separately in the following paragraphs.

The Los Angeles Basin is a subsiding depositional basin with a surficial expression of a lowland coastal plain. The Basin is of primarily Neogene age, with as much as 30,000 feet (9,100 meters) of sediment accumulation in some areas (Yerkes et al. 1965).

Yerkes et al. (1965) provided a compilation of previous geological surveys in the Los Angeles Basin and thoroughly described the geology of that region. In this work, Yerkes divided the Los Angeles Basin into a series of subdivisions or "*structural blocks*" separated by major zones of "*faulting or flexure in the basement rocks*." The Project Site is in the southern portion of the Southwestern Block, as described by Yerkes et al. (1965). Basement rocks are exposed primarily in the Palos Verdes Hills and are composed of metamorphic rocks (Catalina Schist) of Jurassic age (Dibblee 1999). The superjacent rocks in the Southwestern Block are primarily Cenozoic marine and nonmarine sedimentary rocks.

The Project Site is near the crest of the west-northwest-trending Wilmington anticline. The Wilmington anticline is the major structural feature associated with the Wilmington oil field, and is between the Newport-Inglewood Fault and the Palos Verdes Fault Zone. The Wilmington anticline is a broad gently sloping structure about 5 km wide but 18 km long, running through the harbor of Long Beach, California. Because of "*ongoing tectonic deformation throughout nearly all of Quaternary time*," sedimentary deposits near the crest of the Wilmington Anticline have been thinned to remove the youngest sedimentary units (Ponti et al. 2007). Because of this crustal thinning, older Pleistocene age sediments are exposed at or near the surface.

The Pleistocene record in the Los Angeles Basin is unusually complex, involving both marine and continental formations that exhibit rapid vertical and lateral facies changes (Woodford et al. 1954). This complexity of Pleistocene deposition is related to a combination of tectonic uplift and/or subsidence, dramatic climate changes, and frequent glacio-eustatic sea-level fluctuations. Sea level fluctuated during the Pleistocene in response to successive glacial and interglacial stages and contributed to the expansion and contraction of marine conditions across the basin. As a direct result, there is a large variability in the depositional setting, facies relationships, and areal distribution of Pleistocene sediments. During sea-level low stands, alluvial progradation resulted in the retreat of shallow marine embayments and the rapid deposition of fluvial deposits, in part resulting from increased precipitation during the glacial stages (Van Devender and Spaulding 1979; Wright 1989). After the Wisconsin Glacial Stage, the sea withdrew from the northern Los Angeles Basin/San Fernando Valley area and marine sediments were succeeded by freshwater fluvial and alluvial sediments.

5.8.1.3 Resource Inventory Methods

To develop a baseline paleontological resource inventory of the Project Site and surrounding area and to assess the potential paleontological productivity of each stratigraphic unit present, the published as well as available unpublished geological and paleontological literature was reviewed, and stratigraphic and paleontologic inventories were compiled, synthesized, and evaluated (see below). These methods are consistent with CEC (2007) and SVP (1995) guidelines for assessing the importance of paleontological resources in areas of potential environmental effect.

Geologic maps and reports covering the bedrock and surficial geology of the Project vicinity were reviewed to determine the exposed and subsurface rock units, to assess the potential paleontological productivity of each rock unit, and to delineate their respective areal distribution in the Project Area. In addition, aerial photographs of the area were examined to aid in determining the areal distribution of distinctive sediment and soil types. No subsurface exploration was conducted for this assessment.

The number and locations of previously recorded fossil sites from rock units exposed in and near the Project and the types of fossil remains each rock unit has produced were evaluated based on published and unpublished geological and paleontological literature (including previous environmental effect assessment documents [e.g., Lawler and Associates 2001] and paleontological resource effect mitigation program final reports [e.g., Lander 1990; Fisk 2005]). The literature review was supplemented by archival records searches conducted at the University of California Museum of Paleontology (UCMP) in Berkeley, California, at the Natural History Museum of Los Angeles County (LACM) in Los Angeles, California, and at the San Bernardino County Museum in Redlands, California, for additional information regarding the occurrence of fossil sites and remains in the vicinity of the Project.

A field survey, which included visual inspection of exposures of potentially fossiliferous strata in the Project vicinity, was conducted to document the presence of sediments suitable for containing fossil remains and the presence of any previously unrecorded fossil sites. The field survey for this assessment was conducted over the course of several site visits that took place on 13 February, 31 March, 3 through 6 April, and 3 June 2007 and 4 and 5 June 2008 by Dr. Lanny H. Fisk, Ph.D., PG. During the field survey, stratigraphy was observed in numerous road cuts, drainage ditch banks, and trenches and other excavations at nearby construction sites. Excavations at construction sites within the refinery containing up to 15 feet (4.6 meters) of exposed sediments were present within 1 mile of the Project Site (see Confidential Paleontological Resources Technical Report, Figure 2, Exposure of Sandy Sediment at a Site Near to the Project, provided in the Paleontological Resources Technical Report).

5.8.1.4 Paleontological Resource Assessment Criteria

The SVP (1995), in common with other environmental disciplines such as archaeology and biology (specifically in regard to listed species), considers any fossil specimen significant, unless demonstrated otherwise, and, therefore, protected by environmental statutes. This position is held because vertebrate fossils are uncommon and only rarely will a fossil locality yield a statistically significant number of specimens representing the same species. In fact, vertebrate fossils are so uncommon that, in most cases, each fossil specimen found will provide additional important information about the characteristics or distribution of the species it represents.

A stratigraphic unit (such as a formation, member, or bed) known to contain significant fossils is considered to be ‘sensitive’ to adverse effects if there is a high probability that earth-moving or ground-disturbing activities in that rock unit will either disturb or destroy fossil remains. This definition of sensitivity differs fundamentally from that for archaeological resources:

> *“It is extremely important to distinguish between archaeological and paleontological (fossil) resource sites when defining the sensitivity of rock units. The boundaries of archaeological sites define the areal extent of the resource. Paleontologic sites, however, indicate that the containing sedimentary rock unit or formation is fossiliferous. The limits of the entire rock formation, both areal and stratigraphic, therefore define the scope of the paleontologic potential in each case.”* (SVP 1995)

This distinction between archaeological and paleontological sites is important. Most archaeological sites have a surface expression that allow for their geographic location. Fossils, on the other hand, are an integral component of the rock unit below the ground surface, and, therefore, are not observable unless exposed by erosion or human activity. Thus, a paleontologist cannot know either the quality or quantity of fossils present before the rock unit is exposed as a result of natural erosion processes or earth-moving activities. The paleontologist can only make conclusions on sensitivity to effect based on what fossils have been found in the rock unit in the past, along with a judgment on whether or not the depositional environment of the sediments that compose the rock unit was likely to result in the burial and preservation of fossils.

Fossils are seldom uniformly distributed within a rock unit. Most of a rock unit may lack fossils, but at other locations within the same rock unit concentrations of fossils may exist. Even within a fossiliferous portion of the rock unit, fossils may occur in local concentrations. For example, Shipman (1977, 1981) excavated a fossiliferous site using a three dimensional grid and removed blocks of matrix of a consistent size. The site chosen was known before excavation to be richly fossiliferous, yet only 17 percent of the blocks actually contained fossils. These studies demonstrate the physical basis for the difficulty in predicting the location and quantity of fossils in advance of Project-related ground disturbance.

It is, unfortunately, not possible to determine where fossils are located without actually disturbing a rock unit. Monitoring of excavations by an experienced paleontologist during construction increases the probability that fossils will be discovered and preserved. Preconstruction mitigation measures such as surface prospecting and collecting will not prevent adverse effects on fossils because many sites will be unknown in advance due to an absence of fossils at the surface.

The non-uniform distribution of fossils within a rock unit is essentially universal and many paleontological resource assessment and mitigation reports conducted in support of environmental effect documents and mitigation plan summary reports document similar findings (see for instance Lander 1989, 1993; Reynolds 1987, 1990; Spencer 1990; Fisk et al. 1994; and references cited therein). In fact, most fossil sites recorded in reports of effect mitigation (where construction monitoring has been implemented) had no previous surface expression. Because the presence or location of fossils within a rock unit cannot be known without exposure resulting from erosion or excavation, under SVP (1995) standard guidelines, an entire rock unit is assigned the same level of sensitivity based on recorded fossil occurrences.

Using SVP (1995) criteria, the paleontological importance or sensitivity (high, low, or undetermined) of each rock unit exposed in a Project Site or surrounding area is the measure most amenable to assessing the significance of paleontological resources because the areal distribution of each rock unit can be delineated on a topographic or geologic map. The paleontological sensitivity of a stratigraphic unit reflects: (1) its potential paleontological productivity (and thus sensitivity), and (2) the scientific significance of the fossils it has produced. This method of paleontological resources assessment is the most appropriate because discrete levels of paleontological importance can be delineated on a topographic or geologic map.

The potential paleontological productivity of a stratigraphic unit exposed in a Project Area is based on the abundance/densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near a project site. The underlying assumption of this assessment method is that exposures of a stratigraphic unit in a Project Area are most likely to yield fossil remains both in quantity and density similar to those previously recorded from that stratigraphic unit in and near the Project Area.

Under California Environmental Quality Act of 1970 (CEQA) Guidelines section 15064.5(a)(2), public agencies must treat all historical and cultural resources as significant unless the preponderance of evidence demonstrates that they are not historically or culturally significant.

An individual fossil specimen is considered scientifically important if it meets the following criteria.

- Identifiable
- Complete
- Well preserved
- Age diagnostic
- Useful in paleoenvironmental reconstruction
- A type or topotypic specimen
- A member of a rare species
- A species that is part of a diverse assemblage
- A skeletal element different from, or a specimen more complete than, those now available for that species

All identifiable land mammal fossils are considered scientifically important because of their potential use in providing relative age determinations and paleoenvironmental reconstructions for the sediments in which they occur. Moreover, vertebrate remains are comparatively rare in the fossil record. Although fossil plants are usually considered of lesser importance because they are less helpful in age determination, they are actually more sensitive indicators of their environment (Miller 1971) and, thus, as sedentary organisms, more valuable than mobile animals for paleoenvironmental reconstructions. For marine sediments, invertebrate and marine algal fossils, including microfossils, are scientifically important for the same reasons that land mammal and/or land plant fossils are valuable in terrestrial deposits. The value or importance of different fossil groups varies depending on the age and depositional environment of the stratigraphic unit that contains the fossils.

The following tasks were completed to establish the paleontological importance and sensitivity of each stratigraphic unit exposed in or near the Project Site.

- The potential paleontological productivity of each rock unit was assessed based on previously recorded and newly documented fossil sites it contains at and/or near the Project Site.
- The scientific importance of fossil remains recorded from a stratigraphic unit exposed at and/or near the Project Site was assessed.
- The paleontological importance of a rock unit was assessed, based on its documented and/or potential fossil content in the area surrounding the Project Site.

Categories of Sensitivity

In its standard guidelines for assessment and mitigation of adverse effects to paleontological resources, the SVP (1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined.

High Sensitivity. Stratigraphic units in which fossils have been previously found have a high potential to produce additional fossils and are therefore considered to be highly sensitive. In the significance criteria of the SVP (1995), all vertebrate fossils are categorized as having significant scientific value and all stratigraphic units in which vertebrate fossils have previously been found have high sensitivity. In areas of high sensitivity, full-time monitoring is recommended during any project-related ground disturbance.

Low Sensitivity. Stratigraphic units that are not sedimentary in origin or that have not been known to produce fossils in the past are considered to have low sensitivity. Monitoring is usually not recommended nor needed during excavation in a stratigraphic unit with low sensitivity.

Undetermined Sensitivity. Stratigraphic units that have not had any previous paleontological resource surveys or any fossil finds are considered to have undetermined sensitivity. After reconnaissance surveys, observation of artificial exposures (such as road cuts) and natural exposures (such as stream banks), and possible subsurface testing (such as augering or trenching), an experienced, professional paleontologist can often determine whether the stratigraphic unit should be categorized as having high or low sensitivity.

5.8.1.5 Resource Inventory Results

Stratigraphic Inventory

Regional geologic mapping in the vicinity of the Project has been provided by Jennings et al. (1977; 1 to 750,000 scale); Jenkins (1938; 1 to 500,000 scale); and Jennings (1962; 1 to 250,000 scale). Larger scale mapping of the Project Site has been provided by Saucedo et al. (2003; 1 to 100,000 scale); Dibblee (1999; 1 to 24,000 scale); and DMG (2001; 1 to 24,000 scale).

Project Geology

A review of the available geologic literature, recent geologic maps, geotechnical borehole logs, previous mitigation programs, and field observations indicates that two stratigraphic units could be impacted during Project construction activities. Unfortunately, in their geologic maps of the late Cenozoic deposits of the Project vicinity, geologists have not always used formally named stratigraphic units; nor have they consistently used the same map units.

Saucedo et al. (2003; 1 to 100,000 scale), the most detailed and recent geologic map available, mapped the entire Project vicinity as Quaternary older alluvium. However, geotechnical borehole logs and nearby mitigation program results indicate that a marine sedimentary unit is found as shallow as 10 feet (about 3 meters) below ground surface (LeRoy Crandall and Associates 1986; Lander 1990). This is significant because a marine sedimentary unit is not alluvial in origin, and represents an entirely different depositional environment than that of continental alluvium. Lander (1990) indicated that the underlying marine layer was "*probably* *the Palos Verdes Sand*." Thus, although the surficial geology is mapped as Quaternary older alluvium, marine deposits may be encountered at a shallow depth during Project excavations. Saucedo et al. (2003) did not include the Palos Verdes Sand in their mapping, but included Quaternary old marine deposits, which may be correlative with the Pleistocene Palos Verdes Sand. Dibblee (1999) included the Palos Verdes Sand on his map of the Palos Verdes Peninsula and vicinity, although the unit was not differentiated from older alluvium.

In the most recent geological inventory of the area, Ponti et al. (2007) named sedimentary units in the Dominguez Gap region for their position in a sequence stratigraphy model. The units named "Mesa Sequence" and "Pacific Sequence" by Ponti et al. (2007) are considered here to be locally correlative with the Quaternary older alluvium and the Palos Verdes Sand, respectively. Because the Palos Verdes Sand is a recognized geological unit, that nomenclature are followed here. The Quaternary older alluvium and the Palos Verdes Sand are described below.

Quaternary Older Alluvium. Saucedo et al. (2003) described the Quaternary older alluvium as "*old alluvial flood plain deposits, undivided (late to middle Pleistocene)*." These continental deposits are alluvium consisting of clays, silts, sands, and gravels. Ponti et al. (2007) described the "Mesa Sequence" in the region as "*dominantly of fluvial or marginal marine origin*" which "*reflects a prograding shoreline*." Because of the previously described regional tectonic environment and geological structures present in the area, particularly the Wilmington Anticline, sedimentary deposits near the crest of the Wilmington Anticline and the Project Area have been stripped to reveal the older Pleistocene sediment (Ponti et al. 2007). Because of these erosion processes, older Pleistocene sediments are exposed at or near the surface.

Palos Verdes Sand. Arnold and Arnold (1902) first described the Palos Verdes Sand as part of the "San Pedro Series" and designated the type section at Deadman Island, though the authors did not use the Palos Verdes Sand nomenclature. The two exposures discussed by Arnold and Arnold (1902) have since been destroyed. Tieje (1926) first used the term Palos Verdes Formation and described it as consisting of massive and loosely cemented marine sands varying from coarse sand to gravelly quartzose sands with pebbles. Woodring et al. (1946) named the Palos Verdes Sand for exposures of marine deposits in the San Pedro area, and this name is now the USGS recognized name for the sedimentary unit (Jacobs et al. 2000; USGS Geolex). Their description included marine terrace sands and gravels, and excluded non-marine terrace cover from the formation at the Palos Verdes Peninsula exposures (Woodring et al. 1946).

Exposures of the Palos Verdes Sand near the Project Site are described as marine sand and pebble gravel by the DMG (2001) and "*greenish-gray, fine-to-medium-grained sand with traces of silt and clay*" by Lander (1990). Jacobs et al. (2000) reported that at one exposure in San Pedro, California, the uppermost Palos Verdes Sand represents a paleo-tsunami deposit. This deposit is composed of 1 to 2 feet of orange sand and "fossil hash" (Jacobs et al. 2000). At other locations and outcrops in the Los Angeles Basin, the formation is considered non-marine in origin (Woodard and Marcus 1973). The lateral discontinuity of marine and nonmarine facies may be explained by regional paleo-topography and the prograding shoreline at the time of deposition, and by local stratigraphic positions and subsequent erosion processes.

The La Brea Tar Pit of upper Pleistocene age is well known worldwide and is in part derived from the Palos Verdes Sand in the northwestern portion of the Los Angeles Basin. The geology of the La Brea deposit has been described by Wright (1987a, 1987b) and Woodward and Marcus (1973). These workers have subdivided the Palos Verdes Sand into three members (units A, B, and C) that document the gradual transition from deep water marine conditions to non-marine alluvial plain deposition in this area of the Los Angeles Basin.

None of the scientific literature reviewed to date has recognized these subdivisions of the Palos Verdes Sand in the Project vicinity. The Palos Verdes Sand is generally considered to be of a late Pleistocene age based on stratigraphic position, index fossils, radiometric dating, amino acid chronostratigraphy, and other dating methods, although some authors have indicated that the unit may be older.

Paleontological Resource Inventory

An inventory of known paleontological resources previously discovered in the vicinity of the Project is presented in the following paragraphs, and the paleontological importance of these resources is assessed. The literature review and UCMP, LACM, and San Bernardino County Museum archival search conducted for this inventory documented no previously recorded fossil sites within the actual Project Site (UCMP 2007; McLeod 2007; Scott 2008). However, sediments of the Quaternary older alluvium and Palos Verdes Sand have yielded fossilized remains of extinct species of continental vertebrates and other types of fossils at numerous previously recorded fossil sites in the Los Angeles Basin (see below). In addition, fossil remains were found at previously unrecorded fossil sites during the field survey of the Project Site and Project Area conducted for this assessment (see Confidential Paleontological Resources Technical Report, Figure 3, Fossil Bone and Fossil Shell Found at a Locality Within 1 Mile of the Project Site, provided in the Paleontological Resources Technical Report).

Quaternary Older Alluvium. No fossil localities have previously been reported from Quaternary older alluvium at the Project Site. However, significant vertebrate fossils have been reported from sediments within 10 feet of the ground surface beneath deposits mapped as Quaternary older alluvium in several areas of Los Angeles County, and several vertebrate fossil localities are reported from within 1 mile of the Project Site. One fossil locality in similar sediments less than 1 mile north of the Project Site has produced vertebrate fossils of *Mammuthus* (mammoth) at a depth of about10 feet below the surface (McLeod 2007). Other fossil localities are within 2 miles east of the Project Site, and produced specimens of mammoth, camel, and bison (McLeod 2007). There have also been fossils reported from Quaternary older alluvium from numerous other localities within Los Angeles County (Lundelius et al. 1983; Jefferson 1991a, 1991b; McLeod 2007; UCMP 2007). During the field survey for this assessment, several previously unrecorded fossil localities were identified in sediments of the Quaternary older alluvium. Fossils at these localities included a mammalian rib fragment, pelecypods, plant fragments and petrified wood, and a paleosol containing root and burrow casts and molds. In general terms, the depositional environment of these sediments appears to be conducive to burial and preservation, specifically of large vertebrate and plant remains.

Fossils occurring in Quaternary alluvium are valuable to the scientific community, as they provide information about climatic conditions in the not too distant past. The occurrences of large and small mammals are well documented from these and older subsurface deposits, and with further observation of earth-moving activities and prospecting for fossils, more specimens could be unearthed.

Since fossil vertebrates have been previously reported from Quaternary older alluvium within Los Angeles County, vertebrate fossils have been reported in similar deposits not far from the

Project Site, vertebrate fossils were observed in exposures within 1 mile of the Project during the field survey. Because depositional conditions observed in exposures in the vicinity of the Project appear to be favorable for the preservation of fossils, the Quaternary older alluvium is judged to have high sensitivity, based on SVP (1995) criteria. There is a high probability of adverse effects on paleontological resources resulting from Project excavations in Quaternary older alluvium.

Palos Verdes Sand. Sediments of the Palos Verdes Sand have produced a large number of fossil localities throughout the Los Angeles Basin. McLeod (2007) indicated "*a great number of localities … from Late Pleistocene deposits of the … Palos Verdes Sand, too numerous to list here.*" Jefferson (1991a, 1991b) compiled a database of California Late Pleistocene (Rancholabrean North American Land Mammal Age) to earliest Holocene vertebrate fossils from published records, technical reports, unpublished manuscripts, information from colleagues, and inspection of museum paleontological collections at over 40 public and private institutions. He listed 13 individual localities for nonmarine lower vertebrate and avian taxa, and 17 individual sites for mammalian taxa in the Palos Verdes Sand within Los Angeles County that yielded vertebrate fossils of these ages. The La Brea Tar Pit fossil mammal assemblage of upper Pleistocene age is well known worldwide and is in part derived from the Palos Verdes Sand in the northwestern portion of the Los Angeles Basin. This assemblage includes a wide variety of carnivores (canids and felids), small to large ungulate herbivores (cervids, antilocaprids, camelids, equids, suiids), edentates (sloths), and a myriad of small mammals including lagomorphs (rabbits), rodents, insectivores and a variety of birds and lower vertebrates (frogs, lizards and snakes). Many of the fossil specimens represent the best preserved specimens of particular taxa found to date.

Also, a locality less than 1 mile south of Project Site yielded "*abundant fossil remains representing a large diverse faunal assemblage*" (Lander 1990). The fossils from this locality were recovered from a fossil-bearing horizon occurring about 14 to 15 feet (about 4.3 to 4.6 meters) below grade (19 to 20 feet [about 5.8 to 6.1 meters] above sea level). Fossils salvaged from this locality included fish, sharks, and rays, as well as clams, snails, tusk shells, barnacles, crabs, and bryozoans (Lander 1990).

Well-represented marine and shore birds faunas from the Palos Verdes Sand have been described in detail by Miller (1914; 1930) and Miller and DeMay (1942). The bony fish (or osteichthyean fish) record from this formation has been extensively described by Fitch (1967, 1969, 1970). Fossil marine mammals have also been recovered from Pleistocene marine sediments in the Long Beach area.

In addition to the extensive accumulation of vertebrate fossils from the Palos Verdes Sand, a composite invertebrate fauna collected from this sedimentary unit includes a diverse anthropod, bryozoan, amphineura, mollusc (pelecypod and gastropod), scaphopod, porifera, and echinoderm fauna. Many taxa identified to the family and genera taxonomic level are well represented. Mount (1970) described 154 invertebrate species from a locality within the Palos Verdes Sand, which indicated a late Pleistocene age. A late Pleistocene pollen and spore flora has also been recovered and analyzed from exposures of Palos Verdes Sand. This flora was indicative of the late Pleistocene maritime climate during the time of deposition (Fisk 2005).

Since fossil vertebrates have been previously reported from Palos Verdes Sand within Los Angeles County, vertebrate fossils have been reported in similar deposits not far from the Project

Site, the Palos Verdes Sand is judged to have high sensitivity based on SVP (1995) criteria. There is a high probability of adverse effects on paleontological resources resulting from Project excavations in Palos Verdes Sand.

Summary

Although no fossils are known to directly underlie the Project Site, the presence of fossil sites in alluvial deposits of the Quaternary older alluvium and alluvial or marine deposits of the Palos Verdes Sand within 1 mile of the Project Site and elsewhere, suggests a potential for additional similar fossil remains to be uncovered by excavations in these formations during Project construction. Under SVP (1995) criteria, these stratigraphic units have a high sensitivity for producing additional paleontological resources. Identifiable fossil remains recovered from these stratigraphic units during Project construction could be scientifically important and significant.

Identifiable fossil remains recovered during Project construction could represent new taxa or new fossil records for the area, for the State of California, or for a formation. They could also represent geographic or temporal range extensions. Moreover, discovered fossil remains could make it possible to more accurately determine the age, paleoclimate, and depositional environment of the sediments from which they are recovered. Finally, fossil remains recovered during Project construction could provide a more comprehensive documentation of the diversity of animal and plant life that once existed in Los Angeles County, and could result in a more accurate reconstruction of the geologic and paleobiologic history of the Los Angeles Basin.

5.8.2 Environmental Consequences

5.8.2.1 Potential Effects from Project Construction

Potential effects on paleontological resources resulting from construction of the Project primarily involve terrain modification (excavations and drainage diversion measures). Paleontologic resources that could be adversely impacted by ground disturbance and earth moving include an undetermined number of fossil remains and unrecorded fossil sites, associated specimen data and corresponding geologic and geographic site data, and the fossil-bearing strata. Direct effects could result from grading and any other earth-moving activity that would disturb or bury previously undisturbed fossiliferous sediments, making those sediments and their paleontological resources unavailable for future scientific investigation.

The planned grading and deeper excavation at the Project Site could result in significant adverse effects to paleontological resources if those excavations involve disturbance of previously undisturbed sediment. Also, the construction of supporting facilities, such as temporary construction offices, laydown yards, and parking areas, has potential to cause adverse effects on significant paleontological resources, if they also involve extensive new ground disturbance. Thus, any Project-related ground disturbance could have adverse effects on significant paleontological resources. However, with a properly designed and implemented mitigation program, these effects will be reduced to less-than-significant effects.

5.8.2.2 Potential Effects from Project Operation

No effects on paleontological resources are expected to occur from the continuing operation of the Project.

5.8.3 Cumulative Effects

If the Project were to encounter paleontological finds during construction, the potential cumulative effects would be low, as long as mitigation measures were implemented to recover the resources. The mitigation measures proposed in Section 5.8.4, Mitigation Measures, will effectively recover the value to science of any significant fossils uncovered during Project-related excavations.

5.8.4 Mitigation Measures

This section describes proposed mitigation measures that will be implemented to reduce potential adverse effects to significant paleontological resources resulting from Project construction. Mitigation measures are necessary because of potential adverse effects of Project construction on significant paleontological resources within the Quaternary older alluvium and Palos Verdes Sand. The proposed paleontological resource effect mitigation program will reduce to an insignificant level the direct, indirect, and cumulative adverse environmental effects on paleontological resources that could result from Project construction. The mitigation measures proposed in the following paragraphs are consistent with SVP standard guidelines for mitigating adverse construction-related effects on paleontological resources (SVP 1995, 1996).

PALEO-1: Monitoring, Mitigation, and Implementation Programs

Before construction, a qualified paleontologist will be retained to both design a monitoring and mitigation program and implement the program during all Project-related ground disturbance. The paleontological resource monitoring and mitigation program will include the elements listed below.

- Preconstruction coordination.
- Construction monitoring.
- Emergency discovery procedures.
- Sampling and data recovery, if needed.
- Preparation, identification, and analysis of the significance of fossil specimens salvaged, if any.
- Museum storage of any specimens and data recovered.
- Reporting.

Before construction begins, the paleontologist will conduct a field survey of exposures of sensitive stratigraphic units that will be disturbed. Earth-moving construction activities will be monitored wherever these activities will disturb previously undisturbed sediment. Monitoring will not need to be conducted in areas where sediments have been previously disturbed or in areas where exposed sediments will be buried, but not otherwise disturbed.

Before construction begins, construction personnel involved with earth-moving activities will be informed that fossils may be discovered during excavating and that these fossils are protected by laws. Construction personnel will also be briefed on the appearance of common fossils and on proper notification procedures. This worker training will be prepared and presented by a qualified paleontologist.

Implementation of these mitigation measures will reduce the potentially significant adverse environmental effect of Project-related ground disturbance and earth moving on paleontological resources to an insignificant level by allowing for the recovery of fossil remains and associated specimen data and corresponding geologic and geographic site data that otherwise might be lost to earth moving and to unauthorized fossil collecting.

With a well designed and implemented paleontological resource monitoring and mitigation plan, Project construction could actually result in beneficial effects on paleontological resources through the discovery of fossil remains that would not have been exposed without Project construction and, therefore, would not have been available for study. The recovery of fossil remains as part of Project construction could help answer important questions regarding the geographic distribution, stratigraphic position, and age of fossiliferous sediments in the Project Area.

5.8.5 Laws, Ordinances, Regulations, and Standards

Paleontological resources are classified as non-renewable scientific resources and are protected by several federal and state statutes (California State Office of Historic Preservation 1983 Marshall 1976; West 1991; Fisk and Spencer 1994; Gastaldo 1999). The most notable of these statutes are the 1906 Federal Antiquities Act and other subsequent federal legislation and policies, and the State of California's environmental regulations (CEQA Section 15064.5). Professional standards for assessment and mitigation of adverse effects on paleontological resources have been established by the SVP (1995, 1996).

The design, construction, and operation of the Project, including any ancillary facilities, will be conducted in accordance with LORS applicable to paleontological resources. Federal and state LORS applicable to paleontological resources are summarized in Table 5.8-1, Summary of LORS – Paleontological Resources, and discussed briefly below, together with county and city requirements and SVP professional standards.

Table 5.8-1
Summary of LORS – Paleontological Resources

LORS	Applicability	Conformity	Conformance (AFC Section)
Antiquities Act of 1906	Protects paleontological resources on federal lands	Yes	5.8.5.1
CEQA	Fossil remains may be encountered by earth-moving	Yes	5.8.5.2
PRC Sections 5097.5/5097.9	Would apply only if some Project land were acquired by the State of California	Yes	5.8.5.2

Source: PaleoResource Consultants 2008
Notes:
AFC = Application for Certification
CEQA = California Environmental Quality Act of 1970
LORS = laws, ordinances, regulations, and standards
PRC = Public Resources Code

5.8.5.1 Federal Laws, Ordinances, Regulations, and Standards

Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (Public Law [PL] 59-209; 16 United States Code [U.S.C.] 431 *et seq*.; 34 Statute 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federal land. The Antiquities Act of 1906 forbids disturbance of any object of antiquity on federal land without a permit issued by the responsible managing agency. This act also establishes criminal sanctions for unauthorized appropriation or destruction of antiquities. The Federal Highways Act of 1958 clarified that the Antiquities Act applied to paleontological resources and authorized the use of funds appropriated under the Federal Aid Highways Act of 1956 to be used for paleontological salvage in compliance with the Antiquities Act and any applicable state laws.

In addition to the Antiquities Act, other federal statutes protect fossils. The Historic Sites Act of 1935 (PL 74-292; 49 Statute 666, 16 U.S.C. 461 *et seq*.) declares it national policy to preserve objects of historical significance for public use and gives the Secretary of the Interior broad powers to execute this policy, including criminal sanctions. The National Environmental Policy Act of 1969 (PL 91-190, 31 Statute 852, 42 U.S.C. 4321-4327) requires that important natural aspects of our national heritage be considered in assessing the environmental consequences of any proposed project. The Federal Land Policy Management Act of 1976 (PL 94-579; 90 Statute 2743, U.S.C. 1701-1782) requires that public lands be managed in a manner that protects the quality of their scientific values. Paleontological resources are also afforded federal protection under 40 Code of Federal Regulations 1508.27 as a subset of scientific resources.

Federal protection for significant paleontological resources would apply to this Project if any construction or other related Project impacts occurred on federally owned or managed lands.

5.8.5.2 State Laws, Ordinances, Regulations, and Standards

The CEC environmental review process under the Warren-Alquist Act is considered functionally equivalent to that of the CEQA (Public Resources Code [PRC] Section 15000 *et seq*.) with respect to paleontological resources. Guidelines for the Implementation of CEQA, as amended 7 September 2004 (Title 14, Chapter 3, California Code of Regulations: 15000 *et seq*.) define procedures, types of activities, persons, and public agencies required to comply with CEQA. They include as one of the questions to be answered in the Environmental Checklist (Section 15023, Appendix G, Section XIV, Part a) the following: "*Will the proposed project directly or indirectly destroy a unique paleontological resource or site?*"

Although neither CEQA nor the Guidelines define "*a unique paleontological resource or site*," CEQA section 21083.2 defines "*unique archaeological resources*" as "*…any archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:*

(1) Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information

(2) Has a special and particular quality such as being the oldest of its type or the best available example of its type

(3) Is directly associated with a scientifically recognized import prehistoric or historic event."

With only slight modification, this definition is equally applicable to recognizing "*a unique paleontological resource or site.*" Additional guidance is provided in CEQA Guidelines section 15064.5(a)(3)(D), which indicates "*generally, a resource shall be considered historically significant if it has yielded, or may be likely to yield, information important in prehistory or history.*"

Paleontological resources are considered to be significant if they meet the following criteria.

- Provide important information on the evolutionary trends among organisms, relating living organisms to extinct organisms.
- Provide important information regarding development of biological communities or interaction between botanical and zoological biota.
- Demonstrate unusual circumstances in biotic history.
- Are in short supply and in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic localities.

CEQA Guidelines section XVII, part a, of the Environmental Checklist asks a second question equally applicable to paleontological resources: "*Does the project have the potential to . . . eliminate important examples of the major periods of California history or pre-history?*" Fossils are important examples of the major periods of California prehistory. To be in compliance with CEQA, environmental effect assessments, statements, and reports must answer both these questions in the Environmental Checklist. If the answer to either question is "yes" or "possibly," a mitigation and monitoring plan must be designed and implemented to protect significant paleontological resources.

The CEQA lead agency with jurisdiction over a project is responsible for ensuring that paleontological resources are protected in compliance with CEQA and other applicable statutes. California PRC section 21081.6, entitled Mitigation Monitoring Compliance and Reporting, requires that the lead agency demonstrate project compliance with mitigation measures developed during the environmental effect review process.

Other state requirements for paleontological resources management are in PRC Chapter 1.7, Section 5097.5 (Statutes 1965, c. 1136, p. 2792), entitled Archaeological, Paleontological, and Historical Sites. This statute defines any unauthorized disturbance or removal of a fossil site or fossil remains on public land as a misdemeanor and specifies that state agencies may undertake surveys, excavations, or other operations as necessary on state lands to preserve or record paleontological resources. This statute would apply to the Project if any construction or other related Project effects occurred on state-owned or -managed lands, if the state or a state agency were to obtain ownership of Project lands during the term of the Project license, or if construction of any Project linear features (natural gas pipeline, cooling and potable water lines, and/or sewer line) were built on state-, county-, or city-owned lands, including streets and highway right-of-ways.

5.8.5.3 County and City Laws, Ordinances, Regulations, and Standards

California Planning and Zoning Law requires each county and city jurisdiction to adopt a comprehensive, long-term general plan for its development. The general plan is a policy document designed to give long-range guidance to those making decisions affecting the future character of the planning area. It represents the official statement of the community's physical development as well as its environmental goals. The general plan also acts to clarify and articulate the relationship and intentions of local government to the rights and expectations of the general public, property owners, and prospective investors. Through its general plan, the local jurisdiction informs these groups of its goals, policies, and development standards; thereby communicating what must be done to meet the objectives of the general plan. State planning law requires each jurisdiction to identify environmental resources and to prepare and implement policies which relate to the use and management of these resources.

In the Los Angeles County General Plan, Goal C/OS-12 is to protect cultural heritage resources. In the General Plan, paleontological resources are included under the general title "cultural resources," as they also are in CEQA. Section VII of the Los Angeles County General Plan states that cultural heritage resources to be protected include, "*sites and districts of paleontological significance…that are nonrenewable and irreplaceable resources…that were turning points in the prehistory of the county*." Policy C/OS 12.1 "*Supports an inter-jurisdictional collaborative system that protects and enhances the County's cultural heritage resources.*"

The 2002 Carson City General Plan was adopted by the Carson City Council in October 2002. The Cultural Resources Section 4.11-3 contains no specific requirements, regulations, ordinances, goals, or objectives that specifically protect paleontological resources.

5.8.5.4 Professional Standards

The SVP, a national scientific organization of professional vertebrate paleontologists, has established standard guidelines (SVP 1995, 1996) that outline acceptable professional practices in the conduct of paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, and specimen preparation, identification, analysis, and curation. Most practicing professional paleontologists in the nation adhere closely to the SVP's assessment, mitigation, and monitoring requirements as specifically spelled out in its standard guidelines. The SVP's standard guidelines were approved by a consensus of professional paleontologists and are the standard against which all paleontological monitoring and mitigation programs are judged. Many federal and California state regulatory agencies have either formally or informally adopted the SVP's "standard guidelines" for the mitigation of construction-related adverse effects on paleontological resources as a measure of professional practice.

Briefly, SVP guidelines recommend that each project have literature and museum archival reviews and a field survey. If there is a high potential for disturbing significant fossils during project construction, the guidelines also recommend developing a mitigation plan that includes monitoring by a qualified paleontologist to salvage fossils encountered, identification of salvaged fossils, determination of their significance, and placement of curated fossil specimens into a permanent public museum collection (such as the designated state repository for fossils, the UCMP at Berkeley).

5.8.5.5 Agencies and Agency Contacts

No state or local agencies have specific jurisdiction over paleontological resources.

5.8.5.6 Permits Required and Permit Schedule

No state or county agency requires a paleontological collecting permit to allow for the recovery of fossil remains discovered as a result of construction-related earth moving on state or private land in a Project Site.

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DATA ADEQUACY WORKSHEET

Adequacy Issue: Adequate ____ Inadequate ____ Revision No. 0 Date ___

Technical Area: **Paleontological Resources** Project: Watson Cogeneration Steam and Electric Reliability Project Technical Staff: ________

Project Manager: ________ Docket: ________ Technical Senior: ________

Siting Regulations	Information	AFC Page Number And Section Number	Adequate Yes Or No	Information Required To Make AFC Conform With Regulations
Appendix B (g) (1)	...provide a discussion of the existing site conditions, the expected direct, indirect and cumulative impacts due to the construction, operation and maintenance of the project, the measures proposed to mitigate adverse environmental impacts of the Project, the effectiveness of the proposed measures, and any monitoring plans proposed to verify the effectiveness of the mitigation.	Section 5.8.1; pages 5.8-2 through 5.8-11 Section 5.8.2; pages 5.8-11 through 5.8-12 Section 5.8.3; page 5.8-12 Section 5.8.4; pages 5.8-12 through 5.8-13 Appendix K Paleontological Resources Technical Report		
Appendix B (g) (16) (A)	Identification of the physiographic province and a brief summary of the geologic setting, formations, and stratigraphy of the Project area. The size of the paleontological study area may vary depending on the depositional history of the region.	Section 5.8.1; pages 5.8-2 through 5.8-11 Appendix K Paleontological Resources Technical Report		
Appendix B (g) (16) (B)	A discussion of the sensitivity of the Project area described in subsection (g)(16)(A) and the presence and significance of any known paleontologic localities or other paleontologic resources within or adjacent to the Project. Include a discussion of sensitivity for each geologic unit identified on the most recent geologic map in the range of at a scale of 1:100,000 to 1:24,000. Provide rationale as to why the sensitivity was assigned.	Section 5.8.2; pages 5.8-11 through 5.8-12 Appendix K Paleontological Resources Technical Report		

DATA ADEQUACY WORKSHEET

Adequacy Issue: Adequate ____ Inadequate ____

Revision No. 0 Date ___

Technical Area: **Paleontological Resources**

Project: Watson Cogeneration Steam and Electric Reliability Project

Technical Staff: ______

Project Manager: ______

Docket: ______

Technical Senior: ______

SITING REGULATIONS	INFORMATION	AFC PAGE NUMBER AND SECTION NUMBER	ADEQUATE YES OR NO	INFORMATION REQUIRED TO MAKE AFC CONFORM WITH REGULATIONS
Appendix B (g) (16) (C)	A summary of all local museums, literature searches and field surveys used to provide information about paleontologic resources in the Project area described in subsection (g)(16)(A). Identify the dates of the surveys, methods used in completing the surveys, and the names and qualifications of the individuals conducting the surveys.	Section 5.8.1.3; pages 5.8-3 through 5.8-4 Appendix K Paleontological Resources Technical Report		
Appendix B (g) (16) (D)	Information on the specific location of known paleontologic resources, survey reports, locality records, and maps at a scale of 1:24,000, showing occurrences of fossil finds, if known, within a 1-mile radius of the Project and related facilities shall be included in a separate appendix to the Application and submitted to the Commission under a request for confidentiality, pursuant to Title 20, California Code of Regulations, Section 2501 *et seq.*	Appendix K Paleontological Resources Technical Report		
Appendix B (g) (16) (E)	A discussion of any educational programs proposed to enhance awareness of potential impacts to paleontological resources by employees, measures proposed for mitigation of impacts to known paleontologic resources, and a set of contingency measures for mitigation of potential impacts to currently unknown paleontologic resources.	Section 5.8.4; pages 5.8-12 through 5.8-13		

DATA ADEQUACY WORKSHEET

Adequacy Issue: Adequate ____ Inadequate ____ Revision No. 0 Date ___

Technical Area: **Paleontological Resources** Project: Watson Cogeneration Steam and Electric Reliability Project Technical Staff: ______

Project Manager: ______ Docket: ______ Technical Senior: ______

Siting Regulations	Information	AFC Page Number and Section Number	Adequate Yes or No	Information Required to Make AFC Conform with Regulations
Appendix B (j) (1) (A)	Tables which identify laws, regulations, ordinances, standards, adopted local, regional, state, and federal land use plans, leases, and permits applicable to the proposed Project, and a discussion of the applicability of, and conformance with each. The table or matrix shall explicitly reference pages in the application wherein conformance, with each law or standard during both construction and operation of the facility is discussed; and	Section 5.8.5, Table 5.8-1; page 5.8-13		
Appendix B (j) (1) (B)	Tables which identify each agency with jurisdiction to issue applicable permits and approvals or to enforce identified laws, regulations, standards, and adopted local, regional, state and federal land use plans, and agencies which would have permit approval or enforcement authority, but for the exclusive authority of the commission to certify sites and related facilities.	Section 5.8.5; pages 5.8-13 through 5.8-17		
Appendix B (j) (2)	The name, title, phone number, address (required), and email address (if known), of an official who was contacted within each agency, and also provide the name of the official who will serve as a contact person for Commission staff.	Section 5.8.5.5; page 5.8-17		
Appendix B (j) (3)	A schedule indicating when permits outside the authority of the commission will be obtained and the steps the applicant has taken or plans to take to obtain such permits.	Section 5.8.5.6; page 5.8-17		